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NOTES ON INDO-MALAYAN FLEAS, WITH DESCRIPTIONS OF  
NEW SPECIES<sup>1,2</sup>

(SIPHONAPTERA)

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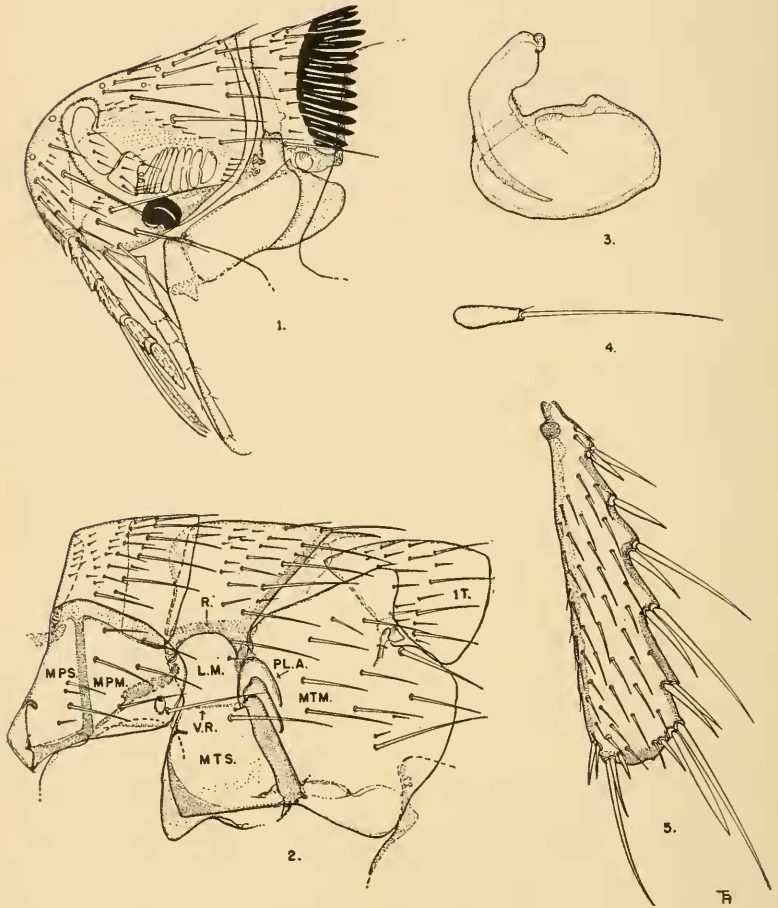
During recent field studies in Malaya on the epidemiology, prevention and treatment of scrub typhus, conducted by the U. S. Army Scrub Typhus Research Unit,<sup>3</sup> it was possible for me to collect a series of fleas which emphasizes how little is known about potentially medically important ectoparasites in the Indo-Malayan area. Included were a new species, a new subspecies, and five little-known species, some of which have never been fully described or figured heretofore. A new genus is proposed for one of these species. All of these were collected on a four-day trip to the hills. Descriptions of a new species collected in North Burma during the recent war and of a new subspecies collected by the National Geographic-Smithsonian Institution-Yale University Expedition to Nepal are also included in the present paper.<sup>4</sup>

<sup>1</sup>Published under the auspices of The Surgeon General, U. S. Army, who does not necessarily assume responsibility for the professional opinions expressed by the author.

<sup>2</sup>Publication costs defrayed in part by the Department of the Army.

<sup>3</sup>The United States Army Scrub Typhus Research Unit was stationed in Kuala Lumpur, Malaya, at the Institute for Medical Research and was supported in part by funds from the Commission on Immunization of the Armed Forces Epidemiological Board.

<sup>4</sup>Abbreviations used in the descriptions are as follows: **A.A.R.**, aedeagal apodemal rod; **A.B.**, antepygidial bristle; **AE.A.**, aedeagal apodeme; **A.I.T.**, armature of inner tube of aedeagus; **A.M.S.**, apical or apico-median sclerites of aedeagus; **AP.A.**, apical appendage of aedeagal apodeme; **AP.R.9**, apodemal rod of ninth sternum; **A.S.**, anal stylet; **A.S.T.**, apical sclerite of inner tube of aedeagus; **B.I.T.**, sclerotized band of inner tube of aedeagus; **CR.**, crochet of aedeagus; **C.S.**, crescent sclerite; **D.A.9**, distal arm of ninth sternum; **D.A.L.**, dorsal anal lobe; **D.I.R.**, dorsal intramural rod of endophallus; **DIV.**, diverticulum at base of aedeagal pouch [*S. calceatus* (R.)]; **D.L.P.**, dorsal lobe of proctiger; **F.**, digitoid or movable finger; **I.R.**, ventral intramural rod of endophallus; **L.L.**, lateral lobes of aedeagus; **L.M.**, lateral metanotal area; **MB.**, manubrium; **M.D.L.**, median dorsal lobe; **MPM.**, mesepimere; **MPS.**, mesepisternum; **MSN.**, mesonotum; **MTM.**, metepimere; **MTS.**, metepisternum; **N.**, neck or constriction of aedeagus; **P.**, immovable process of elasper; **P.A.9**, proximal arm of ninth sternum;



## STIVALIUS INSOLLI SP. NOV.

## PLATE 8.

Fig. 1, head and prothorax, male; fig. 2, meso- and metathorax, male; fig. 3, spermatheca; fig. 4, anal stylet; fig. 5, metatibia.

Family **Pygiopsyllidae**  
 Subfamily **Pygiopsyllinae**

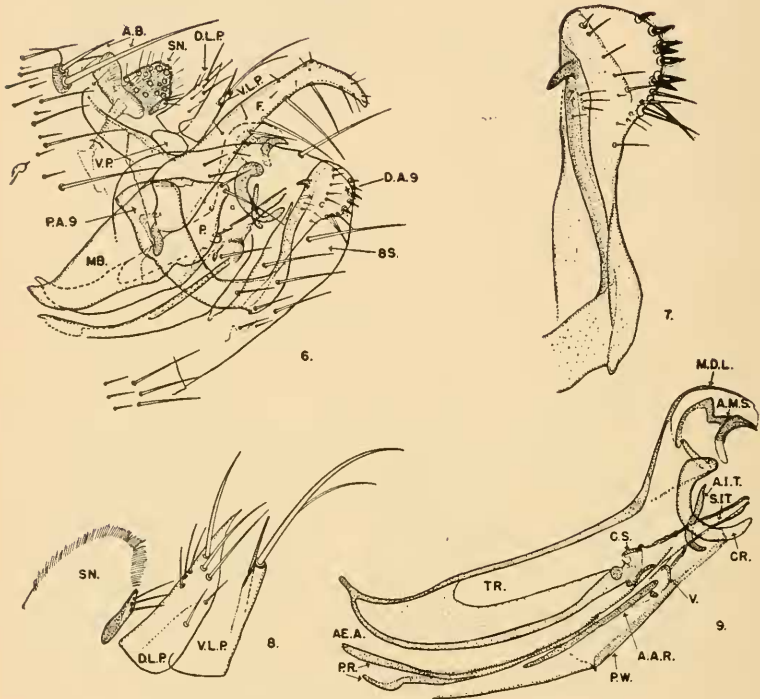
1. **Stivalius insolli**, new species

*Diagnosis.* Distinct from known *Stivalius* in that the pronotal comb consists of about 28 spines instead of the usual 20-22. Near *S. klossi* (Jordan and Rothschild 1922) but readily separable as follows: with only about 16 pre-antennal bristles (fig. 1), not approximately 21 (fig. 21); digitoid (movable finger) with three or four long marginal bristles (fig. 11), not five or six; the apicomedian sclerite of the aedeagus somewhat *M*-shaped (fig. 9, *A.M.S.*); the ventral arm of the aedeagal crochet (*CR.*) shaped like the apex of a small crescent, not large and sagittate (fig. 23, *CR.*); seventh sternum of female shallowly biconcave (fig. 10, *7S*), not with but a single sinus which is about three times as long as broad.

*Description.* *Head* (fig. 1, male). Frontooclypeal margin evenly rounded. Microsetae and/or their pores scattered from first row of bristles to margin of head and dorsad to and above base of antennal groove. First preantennal row with five bristles, excluding a very small one at antennal groove. Second row of three bristles, the uppermost by far the longest. Third preantennal row of four bristles, the uppermost very long and on a level of middle of eye although well anterior to eye; with three very small bristles anterior to ultimate long one. Fourth row with three bristles, the uppermost at a level with penultimate of previous row. Eye well-developed, somewhat kidney-shaped. Maxillary lobe extending slightly beyond base of third segment of maxillary palpi. Labial palpi five-segmented, extending to near apex of forecoxae. Scape of antenna with three or four short thin median bristles. Second antennal segment with a median ring of small bristles and an occasional apical mesal longer one; the apical bristles much shorter than the club. Antennal groove dorsally bordered by a row of small hairs which terminates in a group of five to seven hairs in posteroventral angle of head. Postantennal region with three rows of bristles arranged 3(4)-5-5(6); the lowest bristle is the longest in the case of the last two rows; in addition there is a long bristle bordering the antennal groove and inserted between the last two rows.

*Thorax.* Pronotum with two rows of bristles, the first row very incomplete. Pronotal comb with about 14 spines on a side. Mesonotum with

**PL.A.**, pleural arch of metathorax; **P.R.**, penis rod; **P.S.**, proximal spur of aedeagus; **P.W.**, wall of aedeagal pouch; **R.**, dorsal ridge of lateral metanotal area; **S.I.T.**, sclerotized inner tube; **SN.**, sensillum; **SP.**, spermatheca; **T.AP.9**, tergal apodeme of ninth tergum; **V.**, vesicle; **V.A.L.**, ventral anal lobe of proctiger; **VC.1**, first vinculum; **VC.1A.**, accessory link below first vinculum; **V.I.R.**, ventral intramural rod of aedeagus; **V.L.P.**, ventral lobe of proctiger; **V.P.**, proximal ventral sclerite of proctiger; **V.R.**, ventral ridge of lateral metanotal area; **1T.**, first tergum; **7S.**, seventh sternum; **8T.**, eighth tergum; **8S.**, eighth sternum.



## STIVALIUS INSOLLI SP. NOV.

## PLATE 9.

Fig. 6, modified abdominal segments, male; fig. 7, distal arm of ninth sternum; fig. 8, proctiger, male; fig. 9, aedeagus.

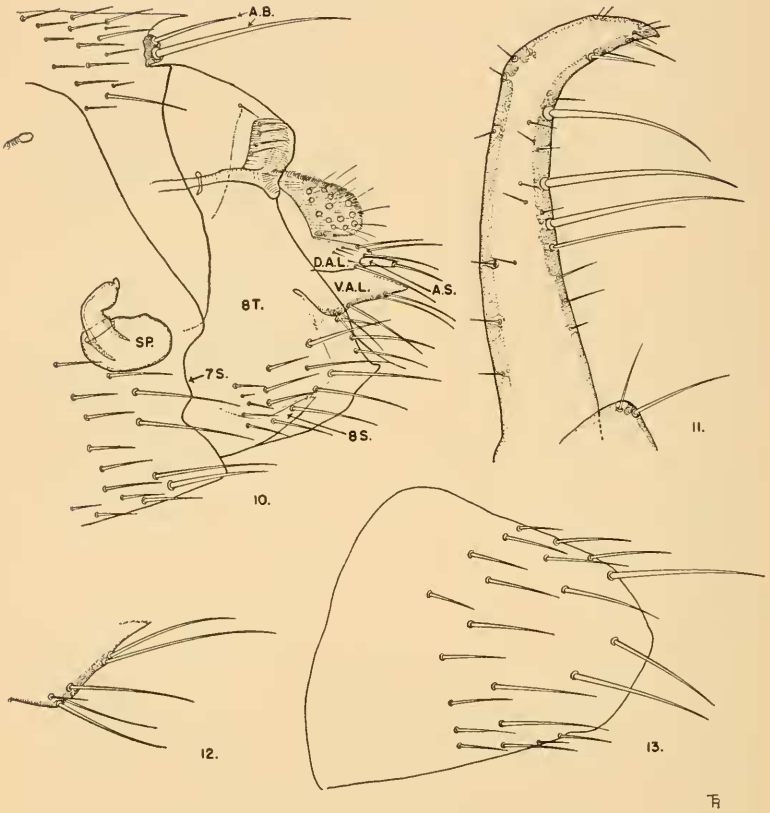
five rows of bristles, those of the first three rows very small; with intercalary small bristles between the long bristles of the last row. Mesonotal flange on each side with a pseudobristle, probably representing a vestigial spiniform. Mesepisternum (fig. 2, *MPS.*) typically with four bristles, two of which are quite small. Mesepimere (*MPM.*) with six bristles arranged 3-3. Metanotum with four rows of bristles, the first highly abbreviated; the bristles of the last row the longest and with intercalary tiny ones. Lateral metanotal area (*LM.*) indicated by a well-developed dorsal ridge (*R.*) and by a weakly-sclerotized ventral ridge (*VR.*); with a long and a short bristle near posterodorsal angle. Metepisternum (*MTS.*) with two bristles at posterodorsal angle, one of these tiny. Pleural arch (*PLA.*) strongly convex, well-developed. Metepimere (*MTM.*) with about 11 long bristles.

*Legs.* Procoxa with many lateral bristles scattered over entire length of segment. Meso- and metacoxae with relatively few such bristles and these marginal or subapical. Metacoxa with a group of mesal thin short bristles near anteroventral angle. Profemur with about three or four thin short lateral bristles and five or six such submarginal bristles. Femora with row of subapical ventromarginal bristles arranged 2-3(4)-3(4). Metatibia (fig. 5.) with but one unpaired dorsolateral large bristle and with four pairs of such bristles; with three apical bristles below the last pair, that near dorsolateral margin the longest, the middle one next longest. Metatibia with about 32 small lateral bristles, excluding strictly marginal ones. Measurements of tibiae and segments of tarsi (petiolate base deleted) shown in microns:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro- .....	170	69	66	42	31	69
Meso- .....	270	143	95	55	33	69
Meta- .....	413	308	215	121	66	110

None of tarsal bristles reaching beyond apex of following segment. Fourth metatarsal segment only slightly wider apically than proximally. Fifth tarsal segment in each case with five lateral plantar bristles, although one of basal pair may be slightly displaced ventrad. Apical ventral subspiniforms on fifth tarsal segments arranged 4-4-2.

*Abdomen.* First tergum (fig. 2, *1T.*) with four rows of bristles, the first row very short. Basal abdominal sternum in female with ten to twelve small thin lateral bristles, in male with four to seven. Terga two to six with one small apical tooth on each side. Typical terga with three rows of bristles, the first row incomplete; the long bristles of the last row much longer than those of other rows, this row extending well ventrad of spiracle. Sternum three in male with two large bristles per side, preceded by about nine small bristles in two or three rows. Typical sterna in male with three large bristles, preceded by four to six smaller ones. In female typical sterna usually bear on each side three large bristles and two irregular rows of about eight smaller ones; sixth sternum with four such large bristles. With two antepygial bristles; in



## STIVALIUS INSOLLI SP. NOV.

## PLATE 10.

Fig. 10, modified abdominal segments, female; fig. 11, digitoid; fig. 12, ventral anal lobe; fig. 13, eighth sternum, male.

male (fig. 6, *A.B.*) upper bristle slightly more than one-third the length of lower one; in female (fig. 10, *A.B.*), upper bristle about half length of lower bristle. Female with a short acuminate process above the antepygial bristles.

*Modified Abdominal Segments.* Male (fig. 6). Eighth tergum reduced to a small indistinct area between antepygial bristles and sensillum; with a few small thin bristles near the very large spiracle. Eighth sternum (*SS.* and fig. 13) very large, extending to level of proximal ventral sclerite of proctiger (*V.P.*) and as far caudad as apex of distal arm of ninth sternum when *in situ*; with about 22 bristles, of which four are dorsomarginal and three or four near ventral margin.

Immovable process of clasper (*P.* and fig. 11) reduced, not produced into a finger-like process; dorsal and dorsocaudal margins mildly sinuate; with two thin apical bristles of unequal size. Movable finger or digitoid (*F.* and fig. 11) essentially of the typical *Stivalius* type but with the caudad-directed apical beak-like portion longer and narrower than in most other species. *F.* about six times as long as broad at maximum; with caudal margin bearing four long bristles, the upper three of which are much longer and stouter than the fourth, which is inserted near midpoint of *F.*; with thinner shorter apical and subapical marginal bristles and widely separated small bristles on the cephalic margin. Sclerite at base of digitoid small, vermiform, directed ventrad. Manubrium (*MB.*) broad, almost half as broad as long; ventral margin with a sharp sinus at apical third. Ninth tergum reduced to an indefinite area between its apodeme and clasper lobe.

Ninth sternum roughly boomerang-shaped. Proximal arm of ninth sternum (*P.A.9*) truncate apically. Distal arm of ninth sternum (*D.A.9* and fig. 7) resembling a mace in shape and in armature on ventral (apparently caudal) aspect of apex; with five or six apical and/or marginal spiniforms (often confused with those of opposite member, *cf.* figure) and three or four stout bristles proximad of these; with a subapical thumb-like process near dorsal margin; with a lateral submedian row of thin bristles and some smaller mesal bristles proximad of the thumb and of the armature.

Aedeagal apodeme (fig. 9, *A.E.A.*) deeply excised due to lengthening of trough of endchamber (*TR.*) which extends far proximad on each side of middle plate. Wall of aedeagal pouch (*P.W.*) ventrally fairly well sclerotized. Median dorsal lobe (*M.D.L.*) strongly arched apically. On each side of *M.D.L.* the apicomedian sclerites (*A.M.S.*) are conspicuous as structures resembling a horizontal letter *M* with curved parallel sides and with one shoulder prolonged into a ventral beak. Crockets (*CR.*) apparently large, somewhat crescentic, but the upper end of the crescent subtruncate and near base of *A.M.S.* Sclerotized inner tube (*S.I.T.*) fairly straight ventral in position, relatively unarmed, but flanked by a pair of slightly curved vermiform sclerites (*A.I.T.*). Apodemal strut supporting inner tube of usual type, but lobes not sharply differentiated. Crescent sclerite (*C.S.*) small but distinct.

Penis rods (*P.R.*) uncoiled, short, not reaching to cephalic end of aedeagal apodeme; united for most their length. Aedeagal apodemal rod (*A.A.R.*) present, arising from base of aedeagus. Vesicle (*V.*) at apex of *A.A.R.* fairly well developed.

Tenth abdominal segment conspicuous by virtue of the highly convex sensillum (fig. 6, *SN.* and fig. 8). Dorsal lobe of proctiger (*D.L.P.* and fig. 8.) conical, with three relatively long subapical bristles and five or six smaller; more proximal ones. Ventral lobe of proctiger (*V.L.P.*) with two long subapical bristles, one much longer than the other.

*Female* (fig. 10). Seventh sternum (*7S.*) with ventral half of caudal margin biconcave, the ventral sinus somewhat deeper than the upper, although both fairly shallow; with four long bristles in two groups of two, preceded by about 11 smaller bristles in an irregular row. Eighth tergum (*8T.*) with about five or six small thin bristles near the large spiracle; with about 17 bristles of varying sizes inserted on subventral portion of the segment; five or six of these are large and form a somewhat horizontal submarginal row. Three of these bristles inserted along caudal margin below the ventral anal lobe. Eighth sternum (*8S.*) greatly reduced, hardly apparent. Dorsal anal lobe of proctiger (*D.A.L.*) with about two or three long dorsomarginal or apical bristles, three or four smaller lateral ones and one ventro-apical bristle. Anal stylet (*A.S.* and fig. 4.) about three times as long as broad at maximum; with a tiny bristle inserted dorsad of base of very long apical bristle. Ventral anal lobe (*V.A.L.* and fig. 12.) not heavily sclerotized, angulate; with four bristles at or near ventral angle, one of which is quite small, and with two long marginal subapical bristles. Spermatheca (*SP.* and fig. 3.) with head about twice as long as tail; head subovate but with a dorsal peak; tail slightly recurved over head.

*Types.* Holotype male and allotype female *ex* a small bird nest found in tree; Malaya: Cameron Highlands, Gunong (= Hill) Brinchong, alt. 4500 ft., 19 July 1948, coll. R. Traub; deposited in U. S. National Museum. A long series of paratypes with same data (R. T. #8214) deposited in the Chicago Natural History Museum, the British Museum, the Rocky Mountain Laboratory of the U. S. Public Health Service, the Canadian National Museum, the author's collection and various other collections. One pair from another bird nest, *ibid.* (R.T. #8206). Two pair from a third such nest, *ibid.* (R.T. #8216).

*Remarks.* The species is named for Mr. Ben Insoll of the Selangor Museum, Quala Lumpur, Malaya, who helped the United States Army Scrub Typhus Unit immeasurably during field experiments and who assisted greatly in the collection of Malayan ectoparasites.

A discussion of bird fleas is pertinent. As defined today, the genus *Ceratophyllus* of the family Ceratophyllidae includes species parasitizing birds and in which the pronotal comb



has a greater number of spines than the near relatives. The genus *Dasypsyllus*, in the same family, is another bird flea, and it too has an unusually large number of spines in the pronotal comb. *Mioctenopsylla* is a circumpolar bird flea, and again the pronotal comb has many spines, but in this case the spines are very short. The author has in press a new genus in the family Pygiopsyllidae taken on a thrush in the Philippines (1). This unique flea, related to New Guinea genera parasitizing mammals, has an unusually large number of pronotal spines. It is of interest to note that the new *Stivalius* here described also has a comb of this type. For this reason, and because such a large series was taken from bird nests, it is believed that the species is a true bird parasite, the first *Stivalius* so reported. The fact that bird fleas so widely separated phylogenetically and geographically agree in this comb character suggests that it is adaptive in nature.

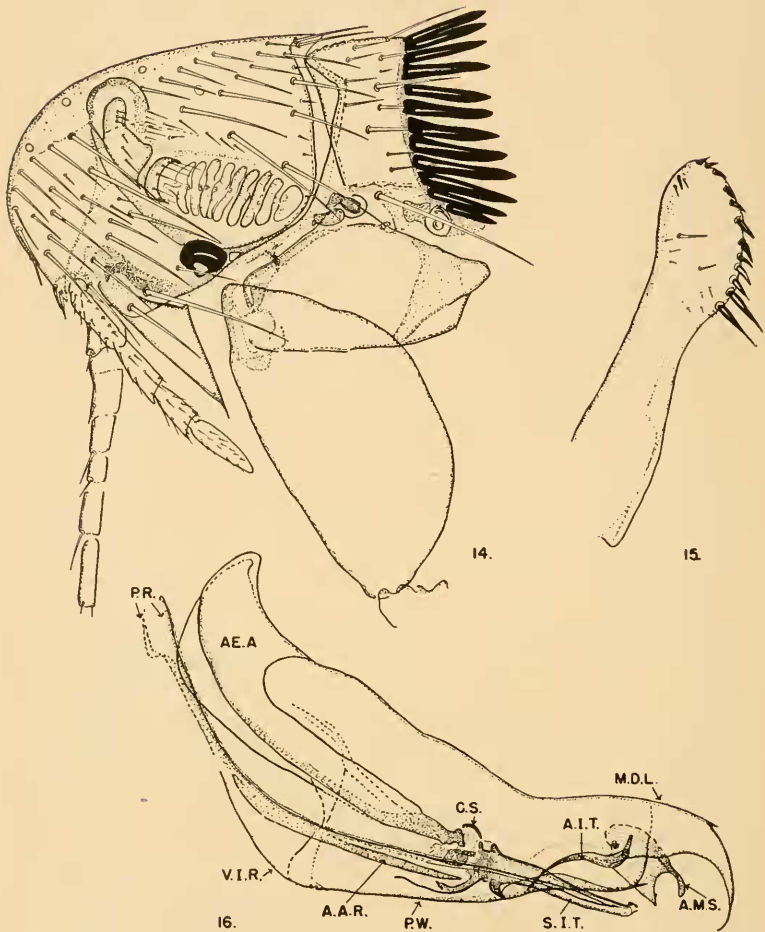
## 2. *Stivalius jacobsoni* (Jordan and Rothschild)

*Pygiopsylla jacobsoni* Jordan and Rothschild, 1922. *Ectoparasites* 1: 228, fig. 221.

*Stivalius jacobsoni* Jordan and Rothschild, 1922. *Loc. cit.*: 250, 263. Dalla Torre, 1924, *Catal.*: 11. Jordon, 1933. *Nov. Zool.* 38: 355. Costa Lima and Hathaway, 1946. *Monog. Instituto Oswaldo Cruz*, No. 4:316.

This species is distinctive in that there is a comb of about 16 spines on the second abdominal segment. Apparently the male has not been described or figured to date. In Malaya two males were collected which agree closely with the original description of this species, and comparison with Javanese material at the British Museum at Tring, through the courtesy of Dr. Karl Jordan, has verified the identification. The description of the Malayan males follows:

*Head and Thorax.* Preantennal region of head (fig. 14) with about 24 bristles in five irregular rows; the lowest five in first row submarginal. Postantennal bristles 5-6-1-6; the dorsal two in the last row submarginal, contiguous. Bristles of second antennal segment short, not reaching beyond proximal fourth of club. Eye well-developed. First pronotal row of bristles incomplete. Pronotal comb with a total of about 23 spines. Mesonotum and metanotum with four rows of bristles; the former with a few additional irregularly placed small bristles near cephalic margin. The first row in each case incomplete. Mesonotal flange with two mesal pseudobristles per side, probably representing vestigial spines. Mesepisternum (fig. 17, *MPS.*) with four bristles; mesepimere (*MPM.*) with four bristles. Lateral metanotal area with three bristles in upper caudal angle, the middle one longest. Metepisternum (*MTS.*) apparently with two bristles in upper caudal angle, one very short. Pleural arch (*PL.A.*)



## STIVALIUS JACOBSONI (J. &amp; R., 1922)

## PLATE 11.

Fig. 14, head and prothorax, male; fig. 15, distal arm of ninth sternum; fig. 16, aedeagus.

well-developed. Metepimere (*MTM.*) with about ten long and four short bristles.

*Abdomen.* Typical terga with three rows of bristles preceded by one or two bristles suggesting a fourth row. Comb on second segment with about 16 spines (fig. 18.); the spines somewhat shorter than those of pronotal comb. Terga three to five with one apical short spine of a size typical for the genus. Basal sternum with five ventromarginal bristles. Typical sterna with a caudal row of three long bristles preceded by six to ten small bristles in one or two rows. With two antepygidial bristles (fig. 19, *A.B.*), of which the upper is little more than half length of lower.

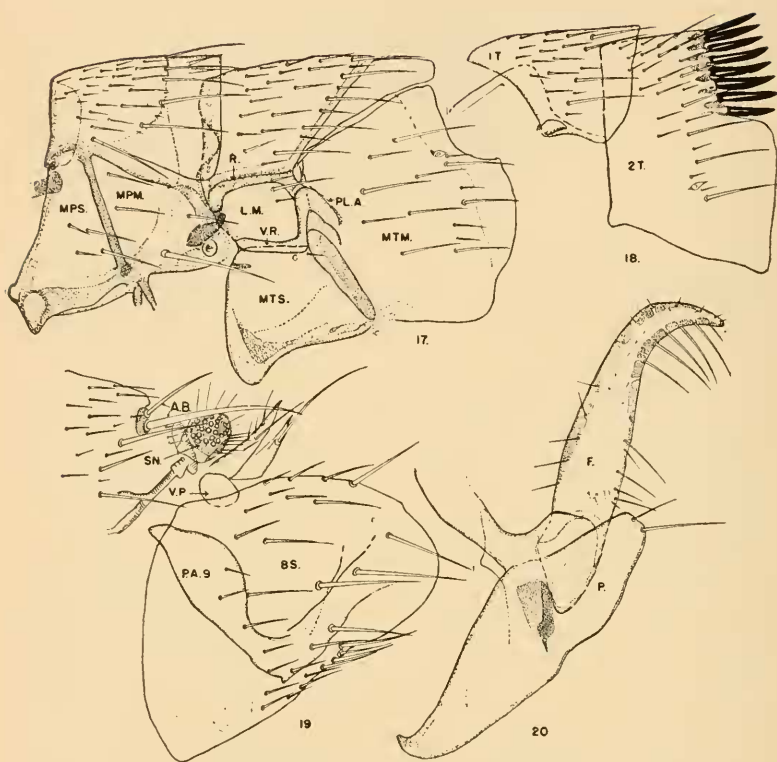
*Modified Abdominal Segments.* Eighth sternum (*SS.*) very large, extending to proximal ventral sclerite of proctiger (*F.P.*) and as far caudad as apex of distal arm of ninth sternum when *in situ*; with about 33 bristles, of which four are dorsomarginal and seven or eight are ventromarginal.

Immovable process of clasper (fig. 20, *P.*) with two thin apical bristles of unequal size. Movable finger or digitoid (*F.*) more than five times as long as broad at maximum; with five fairly stout, long marginal bristles inserted on caudal curve near apex; with three or four fairly long, marginal thin bristles at and below midpoint; with thin scattered bristles on cephalic margin. Sclerite at base of digitoid about twice as long as broad, its long axis at right angles to that of *F.*

Ninth sternum with proximal arm (fig. 19, *P.A.9*) grossly swollen at apical two-thirds, then narrowing to apex. Distal arm of ninth sternum (fig. 15) with apical portion ovoid and bearing a marginal row of about 12 spiniforms, the longest spiniforms most proximad; with two or three short stout bristles on cephalic margin near apex; with two or three median short stout bristles.

The aedeagus of *S. jacobsoni* (fig. 16), while essentially of the same general pattern as *S. insolli* sp. nov. and *S. klossi* (Jordan and Rothschild), shows some highly significant modification. No trace of the crochets can be seen in two mounted specimens (unlike other *Stivalius* known to me). The armature of the sclerotized inner tube (*A.I.T.*) is vermiform but sigmate and extending dorsad so as to lie on *A.M.S.* Apex of median dorsal lobe (*M.D.L.*) highly acuminate, fang-like. The apicomedian sclerites (*A.M.S.*) are deeply excised apically, forming somewhat acuminate apical margins. With a ventral curved spur arising from the base of the sclerotized inner tube.

*Records.* One male *ex Rattus fulvescens* (Gray) or *R. alticola inas* (Bonhote), Malaya: Cameron Highlands, Gunong Brinchong, alt. 5500 ft., 20 July 1948, coll. R. Traub and B. Insoll. One male *ex Rattus fulvescens* (Gray) *loc. cit.* but 19 July 1948.



STIVALIUS JACOBSONI (J.B.R. 1922)

## PLATE 12.

Fig. 17, meso- and metathorax, male; fig. 18, first and second terga, male; fig. 19, portion of modified abdominal segments, male; fig. 20, process and digitoid of clasper.

### 3. *Stivalius klossi* (Jordan and Rothschild)

*Pygiopsylla klossi* Jordan and Rothschild, 1922. Ectoparasites 1: 221 figs. 214, 215.

*Pygiopsylla synctus* Jordan and Rothschild, 1922. *Loc. cit.*: 229, fig. 222.

*Stivalius klossi* Jordan and Rothschild, 1922. *Loc. cit.*: 255, 264. Dalla Torre, 1924. *Catal.*: 11. Jordan, 1933. *Nov. Zool.* 38: 355. Costa Lima and Hathaway, 1946. *Monog. Instituto Oswaldo Cruz*, No. 4: 325, 326.

*Stivalius synctus* Jordan and Rothschild, 1922. *Loc. cit.*: 256, 264. Dalla Torre, 1924. *Catal.*: 11.

The head, thorax and aedeagus of this species have apparently never been figured.

Head (fig. 21) with preantennal region with about 21 bristles arranged in highly irregular rows. Eye quite well-developed, but with the usual ventral excision of *Stivalius*. Postoccipital bristles arranged 4-5-1-5, the odd bristle being just above the middle of the dorsal margin of antennal groove. Pronotum with two rows of bristles, the first incomplete. In the Malayan specimen studied, the length of the spines of the pronotal comb is equal to or greater than that of pronotum, unlike the type (according to original description). Mesonotum with three complete rows of bristles, preceded by one or two irregular rows of very small bristles. Mesepisternum (fig. 22, *MPS.*) with six bristles in or near lower caudal corner. Mesepimere with six bristles arranged 3-3. Metanotum with three complete rows of bristles, preceded by irregular small bristles in one or two rows. Lateral metanotal area (*L.M.*) with three bristles, the middle one longest. Pleural arch well-developed. Metepimere (*MTM.*) with about 16 bristles. With two antepygial bristles, the upper one about half length of lower.

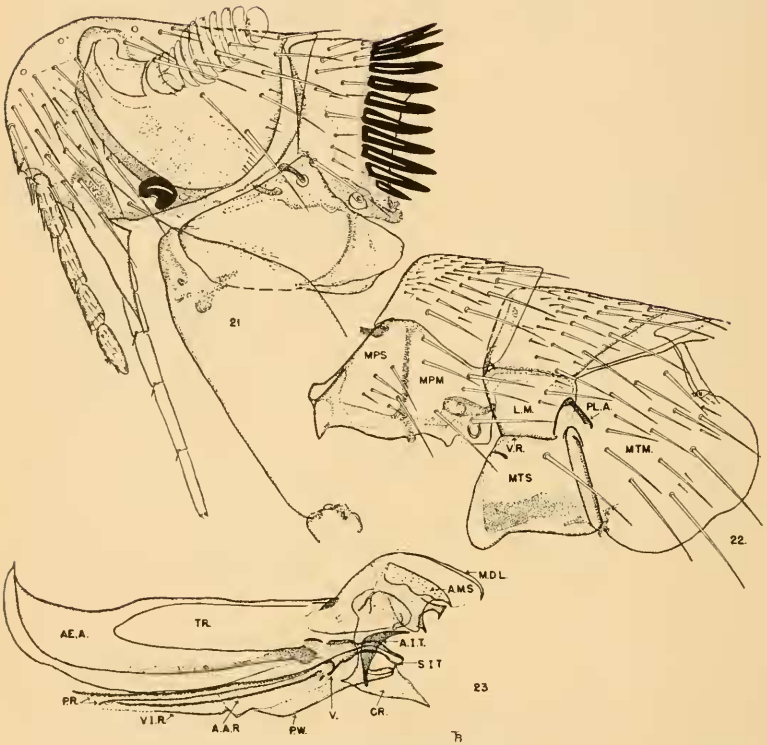
Aedeagus (fig. 23) of same type as in *S. insolli*, and hence only differences are described here. Apicomedian sclerites (*A.M.S.*) very large, dorsal portion slightly mucronate; with a tongue-like truncate apical projection. Crochets (*CR.*) very large, lightly sclerotized (as in *S. insolli*) but apparently consisting of two arms at right angles to each other, the vertical (anterior) arm expanded and rounded apically in vicinity of *A.M.S.*; the horizontal (ventral) arm, or "paramere" apically becoming acuminate, its dorsal margin angulate. Armature of inner tube (*A.I.T.*) shaped like a broad crescent. Sclerotized inner tube (*S.I.T.*) curving ventrad at *A.I.T.*

*Record.* One male *ex Rattus cremoriventer* (Miller). Malaya: Cameron Highlands, Gunong Brichong, alt. 4500 ft., 19 July 1948, coll. R. Traub and B. Insoll.

### 4. *Stivalius robinsoni* (Rothschild)

*Ceratophyllus robinsoni* Rothschild, 1905. *Nov. Zool.* 12:483, pl. 13, fig. 6.

*Pygiopsylla robinsoni* Rothschild, 1908. *Proc. Zool. Soc. London*, p. 617.



STIVALIUS KLOSSI (J. & R., 1922)

PLATE 13.

Fig. 21, head and prothorax, male; fig. 22, meso- and metathorax, male; fig. 23, aedeagus.

Oudemans, 1909. Leiden Nat. Mus. 31:195-200, 1 fig. Rothschild, 1919. Jour. Fed. Malay St. Mus. 8(3):5, pl. 2, figs. 4, 5. Jordan and Rothschild, 1922. Ectoparasites 1:230, figs. 223, 224.

*Stivalius robinsoni* Jordan and Rothschild, 1922. Ectoparasites 1: 259, 265, figs. 223, 224. Dalla Torre, 1924, Catal. :11. Thompson, 1938. Teminckia, London. 3:144. Costa Lima and Hathaway, 1946. Monografias do Instituto Oswaldo Cruz. Rio de Janeiro—Brazil. 4:325. Traub, 1950. Fieldiana. In press.

This species has a wide distribution throughout the Indo-Malayan region and in certain areas seems to be the only species infesting squirrels and *Tupaia*, particularly in the foothills. In Malaya, in the Ulu Gombak Forest Reserve, 16 miles north of Kuala Lumpur, *S. robinsoni* was taken from the following hosts: *Callosciurus hippurus* (Geoffroy), *C. tenuis* (Horsfield), *C. nigrovittatus* (Horsfield), *Lariscus insignis* Currier, *Rhinosciurus laticaudatus* (Müller and Schlegel), and nests of tree squirrels. All collections were made in June and July 1948 by the author for the U. S. Army Scrub Typhus Research Unit.

#### Family Ceratophyllidae

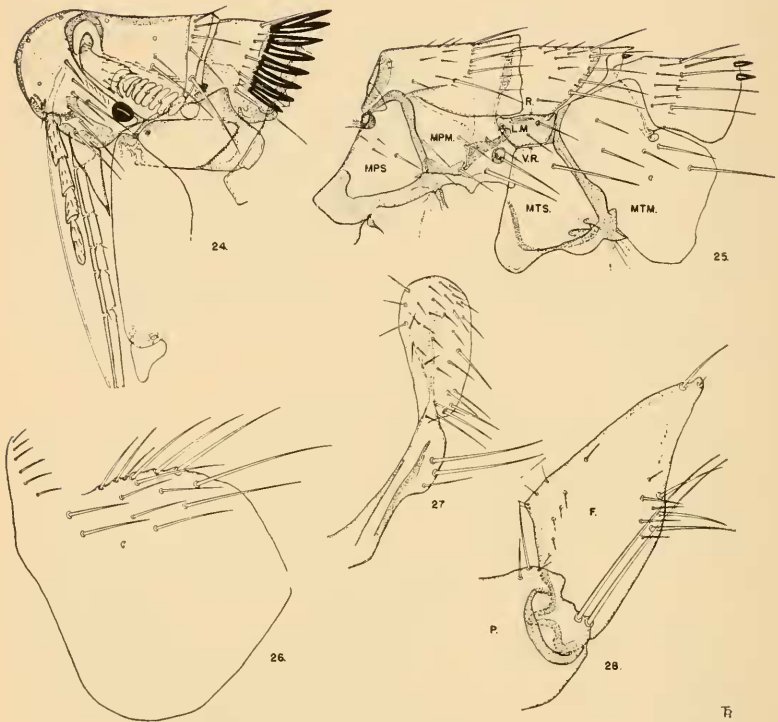
##### Subfamily 1. Ceratophyllinae

As pointed out elsewhere in this paper, the genus *Ceratophyllus* is today restricted to fleas parasitizing birds and in which the pronotal comb consists of a greater number of spines than is found in related genera. Virtually all of the *Ceratophyllus s. lat.* not agreeing with this concept have been placed in new genera. A few species originally called *Ceratophyllus* have not been discussed since this delimitation, although they do not belong in this genus as we now define it. Some of these are known from females only and hence cannot be readily assigned to genus. However, both sexes are known for *calceatus* Rothschild, and additional specimens collected in Malaya enable me to place it in a distinct genus.

##### *Syngenopsyllus*, new genus

Genotype: *Syngenopsyllus calceatus* (Rothschild 1905)

Preantennal region of head (fig. 24) with two rows of bristles. Postantennal region with a complete caudomarginal row of bristles, and two bristles above middle of antennal groove, the lower one large. Pores of microsetae extending onto much of postantennal region. Eye subovate and well-developed. Ontoelypeal tuberele distinct. Labial palpi reaching beyond forecoxae. Pronotal comb with a total of about 18-20 spines. Pronotum with one row of bristles. Lateral metanotal area (fig. 25, *L.M.*) distinct. Lacking a definite pleural arch at junction of lateral metanotal ridge and pleural ridge. Hindeoxa with a few short lateral submarginal or submedian bristles; lacking mesal patch of spiniforms or thin bristles. Foretibia with but one lateral bristle and no mesal bristles.



SYNGENOPSYLLUS CALCEATUS (R, 1905)

## PLATE 14.

Fig. 24, head and prothorax, male; fig. 25, meso- and metathorax male; fig. 26, eighth tergum, male; fig. 27, distal arm of ninth sternum; fig. 28, process and digitoid of clasper.



Tibiae with most of dorsolateral bristles paired. First hind-tarsal segment much shorter than next three segments combined. Each leg with first pair of plantar bristles of last tarsal segment ventral in position. Some of abdominal terga with small apical teeth. Clasper of male (fig. 30, *P.* and fig. 28) lacking the triangular dorsal process of *Myoxopsylla* Wagner. Acetabular bristles below base of dorsal margin of digitoid *F.* Digitoid triangular, directed backwards; lacking spiniforms. Male eighth tergum (*ST.* and fig. 26) not distinctly spiculose near spiracle. Male eighth sternum (*SS.*) with narrow ventral horizontal arm which has no bristles and no fringed flaps. Proximal arm of ninth sternum (*P.A.9*) directed almost straight upwards; somewhat swollen in middle, narrowed apically. Male with but one long antepygidial bristle, others greatly reduced or minute. Female with two stout antepygidial bristles, the lower one very little shorter than the upper. Anal stylet with a long apical bristle and a shorter ventral bristle. Spermatheca with head much longer than broad; longer than tail.

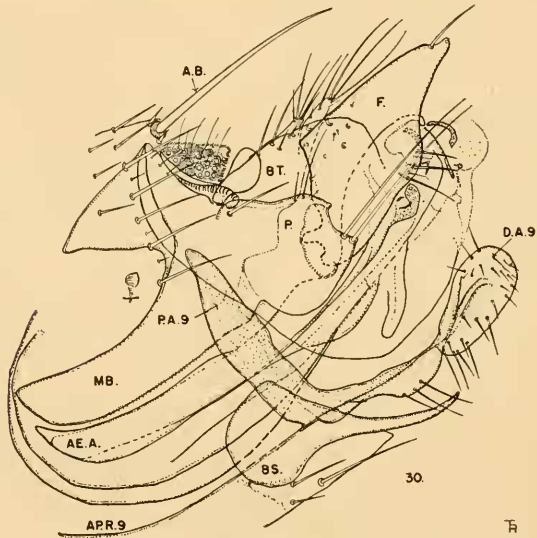
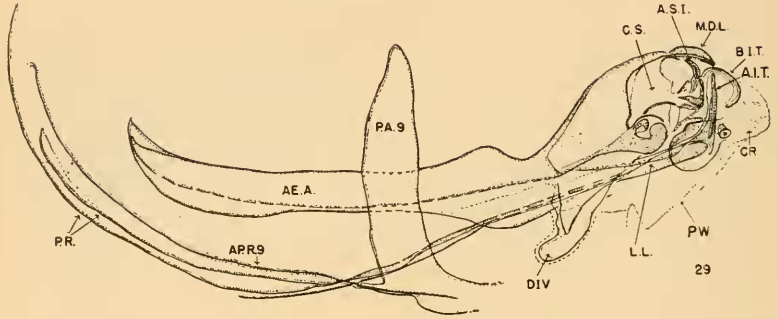
*Comment on Syngenopsyllus.* I am grateful to Dr. Karl Jordan, F.R.S., for having called to my attention the importance of the pleural arch of the metathorax in genera of squirrel fleas. This arch is very much reduced or absent in *Syngenopsyllus*, *Tarsopsylla* Wagner, *Libyastus* Jordan, *Myoxopsylla* Wagner, *Brachyctenotus* Wagner and in the flying-squirrel fleas *Opisodasys pseudarctomys* (Baker) and *O. vesperalis* (Jordan). On the other hand, the pleural arch is highly developed in all *Macrostylophora* Ewing, (e.g., fig. 33, *PL.A.*), in *Monopsyllus sciurorum* (Schrank), *M. rison* (Baker), in *Opisodasys hollandi* Traub, *O. enoplus* (Rothschild), and *O. robustus* (Jordan), in *Orchopeas howardii* (Baker), *O. nepos* (Rothschild), *O. caedens* (Jordan), and in a new *Orchopeas* from Mexico described elsewhere by the author (2.).

The shape of the eighth sternum and of the proximal arm of the ninth sternum in *Syngenopsyllus* suggests *Opisodasys hollandi*. The distal arm of the ninth sternum (fig. 30, *D.A.9*, and fig. 27) also recalls *O. hollandi* but in that species the arm bears many spiniforms instead of bristles. In the characters of the ventral plantar bristles and the bristles above the antennal groove, the new genus resembles *Myoxopsylla*.

1. ***Syngenopsyllus calceatus*** (Rothschild), new combination

*Ceratophyllus calceatus* Rothschild, 1905. Nov. Zool. 12: 481, pl. 13, figs. 3 and 4. Jordan and Rothschild, 1922. Ectoparasites 1: 225, fig. 218. Dalla Torre, 1924. Catal.: 12. Jordan, 1933. Nov. Zool. 38: 352. Costa Lima and Hathaway, 1946. Monog. Instituto Oswaldo Cruz, No. 4: 315.

The Malayan specimens illustrated differ slightly from the figure of the type (also Malayan) and also from a male from



SYNGENOPSYLLUS CALCEATUS (R.1905)

PLATE 15.

Fig. 29, aedeagus; fig. 30, modified abdominal segments male.

Java obtained for study through the cooperation of Dr. Jordan. In my material the labial palpi reach slightly beyond the apex of the fore-trochanters instead of merely slightly beyond the coxae, and the stout bristle on the digitoid is subapical, not apical. These variations cannot be properly evaluated at present, in view of the limited series extant.

The aedeagus is long and narrow, the apodeme (fig. 29, *AE.A.*) about nine times as long as broad at the middle. Wall of aedeagal pouch (*P.W.*) extending as far proximad as level of dorsal concavity at base of median dorsal lobe. With a remarkable large curved diverticulum (*DIV.*) apparently arising from each side of base of pouch. Median dorsal lobe (*M.D.L.*) fairly convex; with a subapical indentation. Proximal spur and apical appendage absent. Crochets (*CR.*) large but feebly sclerotized apicad of the conspicuous peg-shaped sclerotization. Crescent sclerite (*C.S.*) well-developed but almost flat. Sclerotized inner tube vertical distally; with its apex (*A.S.I.*) recurved and angled, paralleling the tube. Inner tube extended as a long narrow band (*B.I.T.*) reaching to crochet. Armature of inner tube (*A.I.T.*) represented as a long thin vertical sclerite. Lateral lobes (*L.L.*) not extending much ventrad of apodemal strut. Penis rods (*P.R.*) uncoiled.

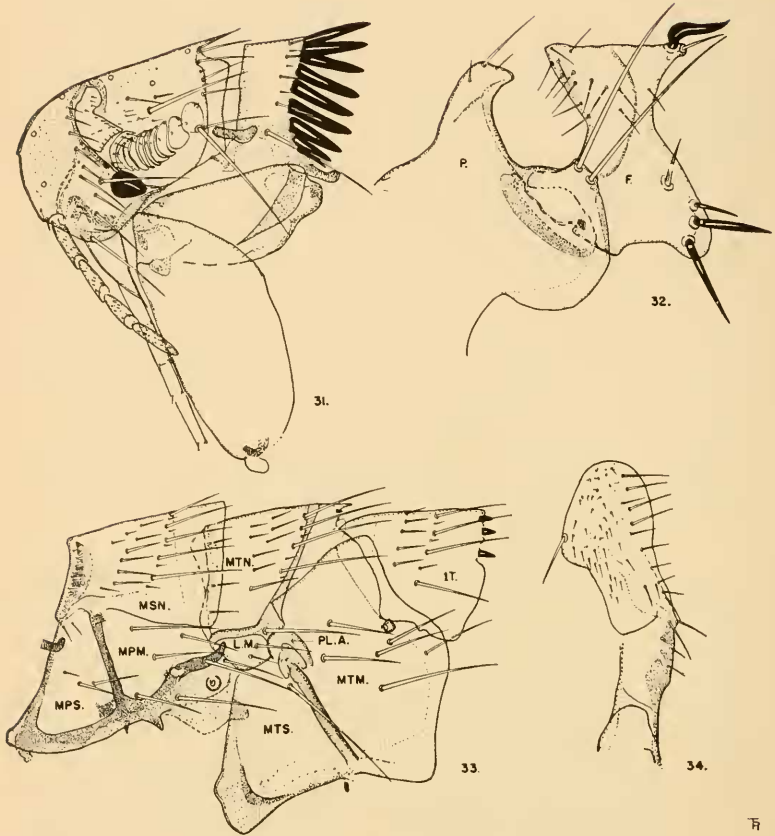
*Record.* Two females from a squirrel nest collected high in a tall tree, Malaya: Cameron Highlands, Gunong Brinchong, alt. 5500 ft., 18 July 1948, coll. R. Traub.

#### Macrostylophora Ewing

The genus *Macrostylophora* has been redefined and well discussed by Jordan (3). This genus is a typical parasite of tree squirrels in the Indo-Malayan region and eleven species have been described. *Macrostylophora hastatus* Jordan and Rothschild is represented by three subspecies: the typical form from Burma, *M. h. sikkimensis* (Jordan and Rothschild) from Sikkim, and *M. h. tonkinensis* Jordan from Tonkin. Two new subspecies are here described—one from Malaya and the second from Nepal. Because the head, thorax and aedeagus and certain other structures have not heretofore been illustrated for this species, the first of the subspecies is described and figured in some detail.

#### 2. *Macrostylophora hastatus malayensis*, new subspecies

*Diagnosis.* Near *M. h. tonkinensis*, but with middle of digitoid *F.* (fig. 32, *F.*) somewhat more constricted, and with fourth subspiniform shifted more apicad, being inserted at proximal fourth instead of adjacent to the other three in ventrocaudal angle (cf. fig. 47, *M. h. tonkinensis*, paratype). Median antepygidial process relatively much longer than in the other subspecies, being six times as long as apex of *P.* is broad, not merely five times; not as straight as the others, but quite convex. Seventh sternum of female (fig. 35, 7*S.*) with



*MACROSTYLOPHORA HASTATUS MALAYENSIS* SSP. NOV.

PLATE 16.

Fig. 31, head and prothorax, male; fig. 32, process and digitoid of clasper; fig. 33, meso- and metathorax; fig. 34, distal arm of ninth sternum.

five bristles on each side, not six as in *M. h. tonkinensis* (fig. 45).

*Description. Head* (fig. 31, male). Ocular row with three large bristles, occasionally with a fourth smaller one between upper two. With five or six small bristles preceding ocular row but with ventralmost at level of eye and upper three or four bordering antennal groove. With two small bristles accompanying the long one above antennal groove. Postantennal region with a marginal row of five or six bristles; at times with a smaller contiguous bristle in addition to the normal long one in ventrocaudal angle.

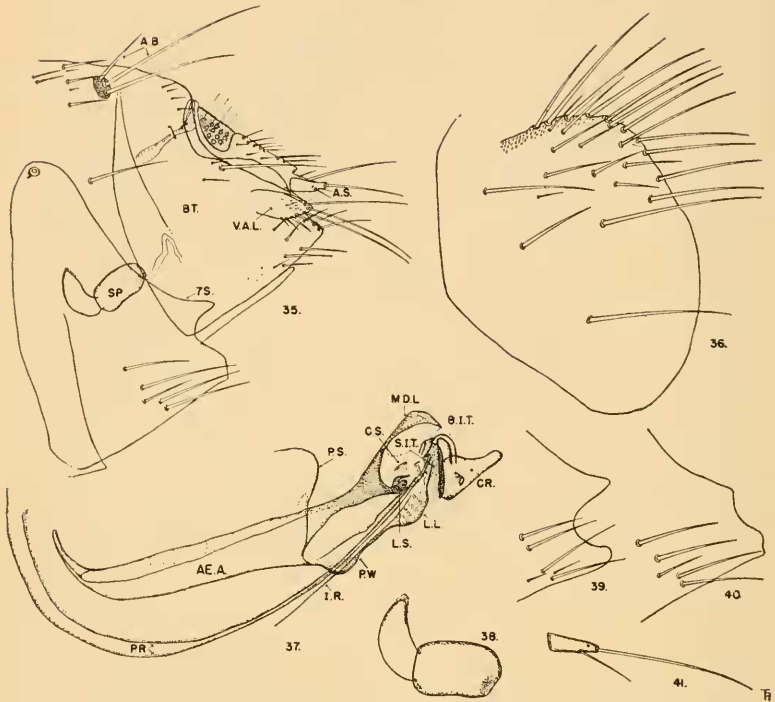
*Thorax.* Pronotum with one row of bristles. Lowest of spines of etenidium much smaller than penultimate which in turn is smaller than those above it. Mesonotum (fig. 33, *MSN.*) with two complete rows of bristles plus two or three subdorsal bristles preceding it; in addition, with four or five very small thin bristles along anterior margin. Mesonotal flange with three mesal pseudo-bristles. Mesepisternum (*MPS.*) with two or three small bristles near antero-dorsal corner and three submedian bristles, of which one may be near ventrocaudal angle. Mesepimere (*MPM.*) with bristles arranged 3-3-1. Metanotum with two complete rows of bristles preceded by about two small bristles; with lateral metanotal area (*L.M.*) well set off by a sclerotized dorsal ridge; with three bristles, including the long one inserted just above the distinct pleural arch (*PLA.*). Metanotal flange with an apical small tooth on each side. Metepisternum (*MTS.*) with a long subdorsal bristle near posterior margin. Metepimere with bristles arranged 2-3-1.

*Legs.* Measurements of male tibiae and segments of tarsi (petiolate base deleted) shown in microns:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro- .....	154	58	60	53	42	83
Meso- .....	248	130	113	61	42	88
Meta- .....	371	303	179	110	64	102

*Abdomen.* First tergum (fig. 33, *1T.*) with two rows of bristles. Basal abdominal sternum without bristles in either sex. Terga one to five in male with tergal bristles arranged (one each side): 3(2)-3-3(2)-2-1(0); in female, 2-2(3)-2-1-0. Typical sterna in male with two bristles on each side; in female these sterna with bristles arranged 2-2-2-3. Male with antepygidial bristles arising from a low but distinct pedestal; with one very long antepygidial bristle and one minute ventral one; prominent chitinized process between the two sets of bristles about three-fourths the length of the long antepygidial bristle. In female, upper antepygidial bristle about one-half length of middle bristle; lower bristle three-fourths length of middle one.

*Modified Abdominal Segments. Male.* Eighth tergum (fig. 36) with about ten long dorsomarginal bristles; about five submarginal dorsal bristles; about six lateral bristles. Movable finger or digitoid *F.* (fig. 32, *F.*) with dorsal margin twice the diameter of the constricted median



FIGS 35, 36, 37, 38, 41, *MACROSTYLOPHORA HASTATUS MALAYENSIS* SSP. NOV.

FIG. 39, *MACROSTYLOPHORA HASTATUS SIKKIMENSIS* (J.B.R., 1922)

FIG. 40, *MACROSTYLOPHORA HASTATUS HASTATUS* (J.B.R., 1921)

PLATE 17.

Figs. 35-38, 41, *Macrostylophora hastatus malayensis*. Fig. 35, modified abdominal segments, female; fig. 36, eighth tergum, male; fig. 37, aedeagus; fig. 38, spermatheca; fig. 41, anal stylet. Fig. 39, *M. h. sikkimensis*, seventh sternum, female. Fig. 40, *M. h. hastatus*, seventh sternum, female.

portion. Digitoid produced into a short nose beyond insertion of stout spiniform at dorsocaudal angle. Most dorsal mesal spiniform of group in ventrocaudal region of digitoid displaced dorsad a distance subequal to own length. Distal arm of ninth sternum (fig. 34) with three marginal bristles and one submarginal bristle on proximal portion; apical portion broadened, distally evenly rounded, with a ventrolateral row of longish bristles, the apical four of which are the longest; with a long bristle on anterior margin, near base of expanded apical portion; intermediate region of apical portion with a network of short thin bristles.

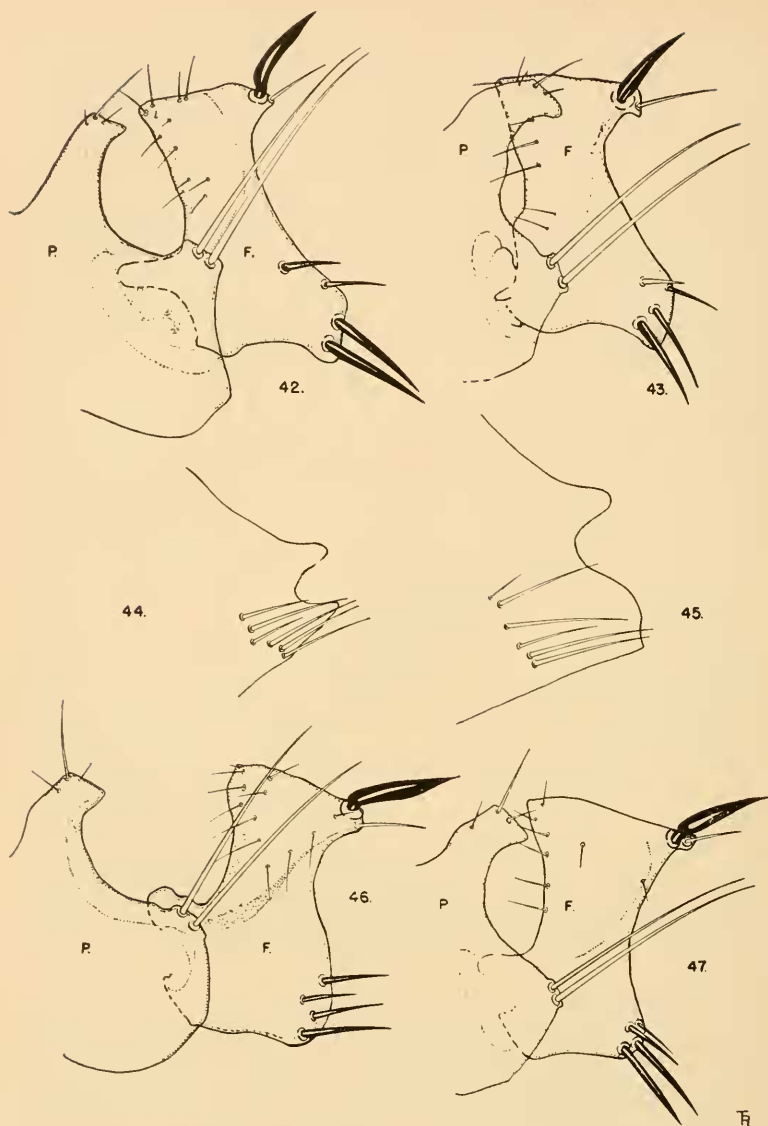
Aedeagus (fig. 37) with apodeme (*AE.A.*) about twice as long as portion distad of proximal spur (*P.S.*). Median dorsal lobe (*M.D.L.*) dorsally straight until near apex. Lateral lobes (*L.L.*) fairly well-developed, convex, extending from an area proximad and ventrad of lateroventral lobe of apodemal strut (*L.S.*) to near apex of sclerotized inner tube. Crochets (*CR.*) large; ventral margins quite straight; base thrice width of apex; dorsal margin sinuate, the pre-apical sinus rather large; apex rounded. Crescent sclerite (*C.S.*) short, almost flat. Sclerotized inner tube (*S.I.T.*) short; oblique; not heavily armored, its armature most apparent as a narrow inverted *U* anterior to apex. Inner tube extended as a narrow sclerotized band (*B.I.T.*) curving to base of crochets. Anterior portion of apodeme produced into a long narrow beak, but not a true apical appendage. Penis rods uncoiled.

*Female* (fig. 35). Seventh sternum (*7S.*) with a deep caudal sinus; upper lobe subaeuminate, ventral lobe somewhat rounded; with five long bristles, although three of these usually longer than others. Eighth tergum (*8T.*) with one long bristle ventrad to sensillum; other bristles smaller and relatively few in number—i.e., three or four ventromarginal, near caudal angle; and three caudomarginal, near ventral anal lobe (*V.A.L.*); two such bristles below *V.A.L.*, which in turn bears three long apical bristles and three small marginal ones, in addition to seven to ten tiny ones more proximad. Anal stylet (*A.S.* and fig. 41) slightly more than three times as long as broad at base. Spermatheca (*SP.* and fig. 38) with head somewhat barrel-shaped but with dorsal and ventral margins subparallel for much of their lengths; about two-thirds broad as long; tail somewhat shorter than head but broad near base and tapering apically.

*Types.* Holotype male and allotype female *ex* nest of tree squirrel; Malaya: Cameron Highlands, Gunong Brinchong, alt. 4500 ft., 19 July 1948, coll. R. Traub; deposited in the U. S. National Museum. Paratypes: four males and five females with same data and one male *ex Callosciurus erythraeus* (Pallas) but otherwise same data; deposited in the Chicago Natural History Museum and the author's collection.

### 3. *Macrostylophora hastatus nepali*, new subspecies

Near *M. h. sikkimensis* Jordan and Rothschild, but with dorsal margin of digitoid (fig. 42, *F.*) shorter in proportion (as shown in Table 1 below); margin of digitoid between



## PLATE 18. MACROSTYLOPHORA SUBSPECIES

Fig. 42, *Macrostylophora hastatus nepali*, process and digitoid of clasper; fig. 43, *M. h. sikkimensis*, process and digitoid of clasper; fig. 44, *M. h. nepali*, seventh sternum, female; fig. 45, *M. h. tonkinensis*, seventh sternum, female; fig. 46, *M. h. hastatus*, process and digitoid of clasper; fig. 47, *M. h. tonkinensis*, process and digitoid of clasper.



Subspecies	Length		Digitoid <i>F.</i>		
	Anteepygidial	Apex	Apex	Middle	Base
	Process	<i>P.</i>			
<i>malayensis</i> ssp. nov. ....	231	39	127	64	178
<i>nepali</i> ssp. nov. ....	168	38	99	61	165
<i>hastatus</i> (J. & R.) .....	178	32	105	64	157
<i>sikkimensis</i> (J. & R.) ....	165	36	108	64	165
<i>tonkinensis</i> Jordan .....	166	36	127	71	138

Table 1. Measurements in microns of length of anteepygidial process and breadth of apex of process *P.* of clasper and apex, middle and base of digitoid *F.* of five subspecies of *Macrostylophora hastatus*.

apical long spiniform and group of spiniforms at ventro-caudal angle evenly concave, not more excised below apical spiniform than elsewhere (fig. 43, *F.*; *M. h. sikkimensis*) without a suggestion of a nose by base of spiniform at upper angle of digitoid.

In a specimen of *M. h. hastatus* from Maymyo, Burma (determined by Dr. Karl Jordan, and examined through his cooperation) the dorsal margin of the digitoid (fig. 46) is relatively broader than either of the above two subspecies, while its posterior margin is convex for half its length. The groups of spiniforms on the digitoid are almost in one straight line, while the ventral margin is less incurved.<sup>5</sup>

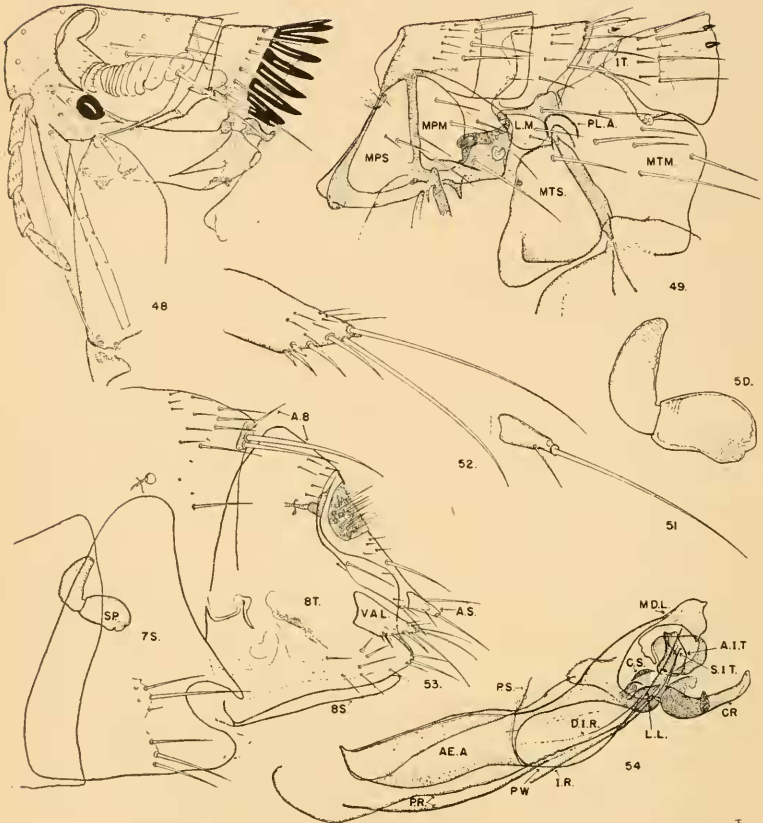
The seventh sternum of the female of *M. h. nepali* ssp. nov. (fig. 44) resembles that of *M. h. sikkimensis* Jordan and Rothschild (fig. 39), *M. h. tonkinensis* Jordan (fig. 45) and *M. h. malayensis* ssp. nov. in being deeply sinuate, forming two distinct lobes, of which the upper is subacute. In a female from Mt. Popa, Burma, again determined as *M. h. hastatus* by Dr. Jordan, who pointed out some differences from the type series, the seventh sternum has a shallow sinus (fig. 40). This segment in *M. h. nepali* ssp. nov. usually bears five or six bristles, of which one is definitely shorter than the others.

*Types.* Holotype male and allotype female *ex Callosciurus* sp., E. Nepal: Dhankuta, 14 February 1949, coll. D. Ripley, H. Weaver and R. Mack; deposited in U. S. National Museum. Paratypes: two males and two females with same data; in Chicago Natural History Museum and in the author's collection.

#### 4. *Macrostylophora levis* (Jordan and Rothschild)

*Ceratophyllus levis* Jordan and Rothschild, 1922. Ectoparasites 1: 219; fig. 213, male only.

<sup>5</sup>Jordan (3) points out that the Maymyo specimens are intermediate in some respects between the type of *M. h. hastatus* and *M. h. sikkimensis*, but he tentatively considered them as being the typical subspecies.



MACROSTYLOPHORA LEVIS (J & R, 1922)

PLATE 19.

Fig. 48, head and prothorax, male; fig. 49, meso- and metathorax, male; fig. 50, spermatheca; fig. 51, anal stylet; fig. 52, ventral anal lobe; fig. 53, modified abdominal segments, female; fig. 54, aedeagus.

*Macrostylophora levis* Jordan, 1939. Nov. Zool. 41: 367. Costa Lima and Hathaway, 1946. Monog. Instituto Oswaldo Cruz No. 4: 268.

This species has been known but from one specimen, the type male, collected in Malaya. The allotype female is here described, along with heretofore undescribed structures of the male.

*Description. Head* (fig. 48, male). Ocular row with middle bristle shorter than the one above and below it. With two shorter bristles preceding this row but inserted at level of eye.

*Thorax.* Pronotum with one row of bristles and a comb of about 17 spines. Mesonotum with two rows of bristles and with one or two bristles as vestiges of a preceding row. Mesonotal flange with three pseudo-bristles on each side. Mesepisternum (fig. 49, *MPS.*) with three or four submedian bristles, one or two of which are quite small. Mesepimere (*MPM.*) with six bristles arranged 3-3. Metanotum with two rows of bristles and with one apical small tooth on each side of flange. Lateral metanotal area (*L.M.*) with a well-developed dorsal ridge; with three bristles, the dorsalmost largest and inserted over the prominent pleural arch (*PL.A.*). Metasternum with a long bristle at posterodorsal angle. Metepimere with about six bristles arranged 2-3-1.

*Legs.* Measurements of male tibiae and segments of tarsi (petiolate base deleted) shown in microns:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro- .....	132	50	52	41	36	83
Meso- .....	215	91	85	64	41	83
Meta- .....	303	248	149	95	58	91

*Abdomen.* First tergum (*1T.*) with two rows of bristles and with two apical small teeth on each side. Terga two to five with apical teeth arranged 2-2-1(2)-1 in male, 2-1-1-0 in female. Typical sterna in male with two bristles on each side but sixth sometimes with an additional small one on one side; in female these sterna with three bristles. Female with middle antepygidial bristle more than twice length of upper bristle, but somewhat less than twice length of lower one.

*Modified Abdominal Segments. Male.* The claspers and associated segments have been well described and figured by Jordan. Aedeagal apodeme (fig. 54, *AE.A.*) slightly shorter than portion apical of the prominent proximal spur (*P.S.*). Wall of aedeagal pouch (*P.W.*) somewhat sclerotized ventrally. Lateral lobes (*L.L.*) not prominent. Median dorsal lobe (*M.D.L.*) slightly convex subapically. Crochets (*CR.*) very large, each shaped like a stout incomplete ellipse; apex of long arm sub-acuminate. Crescent sclerite (*C.S.*) rather broad. Sclerotized inner tube (*S.I.T.*) flanked by a stout, somewhat bent sclerite (*A.I.T.*) about twice as long as broad at base and slightly narrower apically than at base. Laterad on each side of this armature of the inner tube is a large somewhat ameboid sclerite extending apicad to downward-projecting apex of *M.D.L.* Penis rods uncoiled. Ventral intramural rod of endophallus

(*I.R.*) fairly well sclerotized; dorsal intramural rod (*D.I.R.*) slightly so.

*Female* (fig. 53). Seventh sternum (*7S.*) with a large deep sinus; upper lobe acuminate, ventral lobe rounded; with five long bristles arranged in two groups of two (dorsal) and three (ventral), but at times with a tiny additional bristle below the lower one of the dorsal group. Eighth tergum (*8T.*) with one long submedian bristle somewhat below sensillum and six to ten subventral ones, as well as three caudomarginal bristles. Ventral anal lobe (*V.A.L.* and fig. 52) with two very long apical bristles, a much shorter, stout subapical one, three short stout ones at lower angle and an additional marginal one between these two groups; with three dorsomarginal bristles and four median short ones. Anal stylet (*A.S.* and fig. 51) nearly three times as long as broad at base; with a ventral subapical bristle and a long apical bristle. Spermatheca (*SP.* and fig. 50) with dorsal margin of head convex, ventral margin less so; tail slightly longer than head and broadest at proximal fifth.

*Allotype and Records.* Allotype female *ex Callosciurus tenuis* (Horsfield); Malaya: Cameron Highlands, Gunong Brinchong, alt. 5500 ft., 18 July 1948, coll. R. Traub; deposited in U. S. National Museum. Nine males and eight females, with same data deposited in British Museum, Chicago Natural History Museum and author's collection.

#### 5. *Paraceras* species

A single male close to *Paraceras javanicus* Ewing was collected from *Rattus edwardsi* (Thomas); Malaya: Cameron Highlands, Gunong Brinchong, alt. 5500 ft., 19 July 1948, coll. R. Traub. The somewhat deformed specimen shows differences in chaetotaxy and genitalia from *P. javanicus* but its exact status cannot be determined at present because of the limited amount of material.

#### Subfamily 2. *Leptopsyllinae*

In this subfamily I include *Leptopsylla* Jordan and Rothschild, *Peromyscopsylla* I. Fox, *Acropsylla* Rothschild, *Pectinoctenus* Wagner, *Paraectenopsyllus* Wagner, and a new genus from the Philippines described elsewhere (1). This concept would correspond to Jordan's interpretation of *Leptopsyllidae* (4). Certain other workers place some or all of these genera in the *Hystrichopsyllidae*, mainly on the presence of a genal comb and because of the type of antennal groove in some forms. However, as I point out elsewhere (2), *Leptopsylla* is a typical *Ceratophyllid* flea in that the male eighth tergum is very large and covers much of the genitalia, the third aedeagal rod arises from the angle of the ninth sternum and not from the aedeagus *per se*, and the crochets are large and articulated. The other genera above agree in these features, and Jordan (4) cites other morphological reasons for placing these fleas with the *Ceratophyllid* genera. Of these, the genus *Acropsylla* to

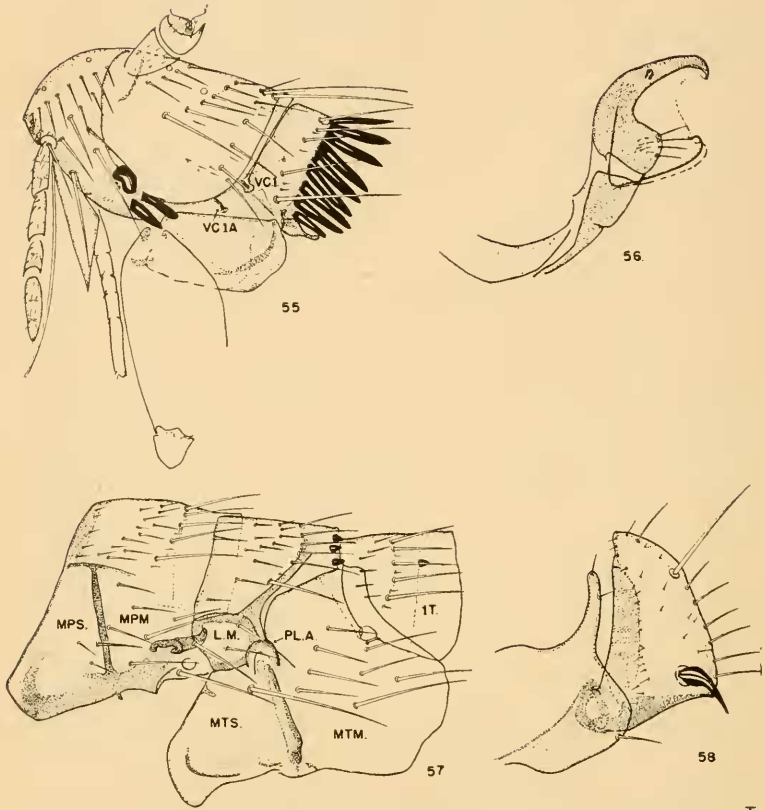
date has included but one species, *A. episema* Rothschild, which was described from a single female and which has not been reported since the original description. Dr. Karl Jordan, of the British Museum at Tring, has kindly compared specimens collected in Burma by members of the United States of America Typhus Commission with the type. He agrees that these represent a distinct species close to *A. episema*.

1. *Acropsylla girshami*, new species

*Diagnosis.* Separated from *A. episema* Rothschild by the absence of a distinct snout at the anteroventral corner of the head in the female. While there is some variation in the size of this extension in the series of 15 females examined, in none does it approach the pronounced snout of *A. episema*. First abdominal tergum in female with a total of two small apical teeth, not four; metanotum with five or six such teeth, rarely seven, instead of eight as in *A. episema*.

*Description.* *Head* (fig. 55, male). Fronto-clypeal margin evenly rounded. Preantennal region with bristles arranged 8-5-3; those of first row small; those of ocular row the longest and somewhat irregularly placed, the middle bristle usually out of line and near to uppermost, at level of eye. Eye fairly well developed; somewhat kidney-shaped, the excision ventral; with two small pores near ventral margin (and another pair of pores at ventral margin near insertion of maxillary lobe). Genal ctenidium of two spines, uppermost slightly narrower and longer than lower one. Maxillary lobe extending beyond apex of third segment of maxillary palpi. Labial palpi not extending beyond apical fourth of forecoxae; with apical (fifth) segment long, almost twice length of fourth and thrice length of unusually small third segment. Scape of antenna with six or seven very small lateral or submarginal bristles. Second antennal segment with marginal bristles shorter than segment is broad. Postantennal bristles arranged 4-6-8, but the last row with two in lower angle of head and three of these bristles in upper angle (two of these very long). With first vinculum (*VC.1*) received in a sinus of prosternosome, but with a well-developed accessory vinculum (*VC.1A.*).

*Thorax.* Pronotum with one row of bristles and a comb of about 18 spines. Mesonotum with a row of small anteromarginal bristles and three median rows, the first of these incomplete and/or irregular; those of last row long. Mesonotal flange with two or three mesal pseudobristles on each side. Mesepisternum (fig. 57, *MPS.*) with two to four bristles near ventrocaudal angle. Mesepimere (*MPM.*) with about eight bristles, usually arranged 3-3-2. Metanotum with three rows of bristles, those of ultimate row the longest. Metanotal flange with five or six apical teeth (total). Lateral metanotal area (*L.M.*) distinct; its borders well sclerotized; with two fairly large bristles. Metepisternum (*MTS.*) with a bristle inserted below the lateral metanotal area. Pleural arch (*PLA.*) well-developed. Metepimere (*MTM.*) with about eight long bristles usually arranged 4-3-1 but frequently with an additional small one immediately below the subpyriform spiracle.



## ACROPSYLLA GIRSHAMI SP. NOV.

## PLATE 20.

Fig. 55, head and prothorax, male; fig. 56, distal arm of ninth sternum; fig. 57, meso- and metathorax, male; fig. 58, process and digitoid of elasper.

*Legs.* Procoxae with many lateral bristles scattered over their entire length. Mesocoxae virtually nude except for anteromarginal bristles. Metacoxae with proximal third nude; remainder with a few lateral and mesal short thin bristles near anterior margin and near apex. Profemora with about 12-14 thin lateral bristles. Other femora with about three to six dorsomarginal and two ventromarginal larger bristles, most of these subapical; in addition, with two lateral subapical bristles. Most of dorsolateral bristles of tibiae paired. Measurements of male tibiae and segments of tarsi (petiolate base deleted) shown in microns:

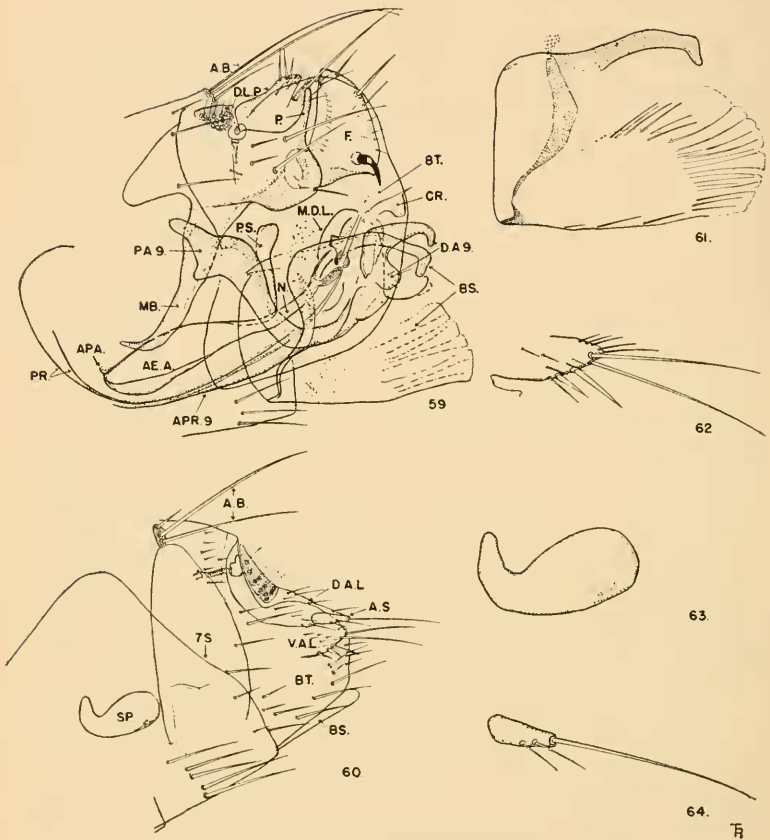
Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro- .....	110	31	39	31	23	55
Meso- .....	165	58	64	44	28	60
Meta- .....	234	146	95	55	33	63

All tarsal bristles quite short, none reaching to apex of following segment. Fifth tarsal segment in each case with four lateral plantar bristles, the basal pair subventral.

*Abdomen.* First tergum (fig. 57, *1T.*) with three rows of bristles, the first incomplete. Basal abdominal sternum with one bristle on each side. Terga one to five in male with an apical small tooth on each side; in female the teeth are present on only the first three terga. Typical terga with the caudal row of large bristles extending to or slightly beyond level of spiracles; first row slightly shorter. Typical sterna with three bristles, of which the uppermost frequently is quite small, but sixth sternum in male usually with four bristles. Male with three very thin antepygidial bristles (fig. 59, *A.B.*); the lowest about one-third length of the others, which are very long. Female antepygidial bristles (fig. 60, *A.B.*) also very thin; lowest bristle about three-fourths length of middle one but slightly more than thrice length of uppermost.

*Modified Abdominal Segments. Male* (fig. 59). Eighth tergum (*8T.*) very large, extending caudad of *F.* and well ventrad of angle of ninth sternum; with relatively few bristles—three large median ones, all inserted in a vertical line commencing near base of digitoid, the uppermost submarginal; two short ones near spiracle and three or four very small dorsomarginal bristles near proctiger.

Immovable process of elasper (*P.* and fig. 58) long and narrow, finger-like and slightly curved cephalad; with a small apical bristle, another somewhat below apex on posterior margin; typical acetabular bristles absent, but with a marginal bristle below the insertion of the digitoid, probably a homologue of one of the acetabular bristles. Movable finger or digitoid (*F.* and fig. 58) large; its apical sixth extending above apex of *P.*; roughly, broadly subtriangular with base of triangle slightly sinuate and somewhat shorter than sides; posterior margin curving rather pronouncedly at apical fifth. Digitoid with a stout downward-curving mesal spiniform inserted near ventrocaudal angle; posterior margin with a row of six thin bristles, then a long mesal bristle inserted at apical fifth, and with two subapical thin bristles, the uppermost quite small;



*ACROPSYLLA GIRSHAMI* SP. NOV.

PLATE 21.

Fig. 59, modified abdominal segments, male; fig. 60, modified abdominal segments, female; fig. 61, eighth sternum, male; fig. 62, ventral anal lobe; fig. 63, spermatheca; fig. 64, anal stylet.



anterior margin with one apical and two subapical bristles; a row of about 15 very small bristles bordering the sclerotized portion near the anterior margin; with about six to eight scattered but similar very small bristles. Manubrium (*MB.*) long and narrow, about four times as long as broad near base; margins mildly sinuate; apex subacuminate.

Ninth sternum roughly boomerang-shaped. Proximal arm of ninth sternum (*P.A.9.*) expanded at proximal third, the upper margin becoming markedly convex; apex consisting of a dorsal finger-like projection and a ventral thumb. Distal arm of ninth sternum (*D.A.9* and fig. 56) with apical portion produced into a huge talon-shaped structure; with four marginal bristles near base of talon, and with about eight median tiny bristles; apparently with a narrow tongue-like projection from below base of apical talon, the tongue perhaps with aedeagal associations, but also with semi-membranous connections with apex of talon.

Eighth sternum (*SS.* and fig. 61) remarkable; very large, but without bristles, ventral portion semi-membranous and extending as far caudad as apex of distal arm of ninth sternum on each side; with a sclerotized portion arising near base of sternum and curving caudad and dorsad to top of segment, there extending along dorsal margin as a heavily sclerotized structure with a downward-projecting beak-like apex resembling that of ninth sternum. Certain of the aedeagal structures cannot be seen in the few males available for study, but it is evident that the aedeagus is not only a typical Ceratophyllid form but that it is essentially like that of *Leptopsylla*. Aedeagal apodeme (*AE.A.*) slightly longer than the portion distad of the very long and broad proximal spur (*P.S.*); with a long and narrow neck (*N.*) between proximal spur and apodemal strut. Median dorsal lobe (*M.D.L.*) feebly sclerotized, subapically convex. Crochets (*CR.*) very large, shaped like a battle-axe with the shaft prolonged into a spike distad of the head. Apical appendage (*AP.A.*) short but distinct. Penis rods (*P.R.*) uncoiled, but much longer than the apodemal rod of the ninth segment (*AP.R.9*).

Dorsal lobe of proetiger (*D.L.P.*) short and broad, distinct, with a dorso-marginal row of six to seven bristles, of which the first three are relatively large, and with three to four median small bristles. Ventral lobe of proetiger with a marginal row of eight to ten bristles, the two at ventrocaudal angle the longest.

*Female* (fig. 60). Seventh sternum (*7S.*) without lobes or a sinus; lower portion of caudal margin almost straight; with a row of four or five long bristles (the fifth uppermost, sometimes short and frequently missing). Eighth tergum (*8T.*) with about ten to eleven bristles ranging from below sensillum to near ventral margin, excluding three ventromarginal bristles, three or four caudomarginal bristles, and two mesal ones below ventral anal lobe. Eighth sternum (*SS.*) reduced but apparent; without bristles. Dorsal anal lobe (*D.A.L.*) with about two irregular rows of short thin bristles and four to five dorsomarginal bristles, the last two the longest. Anal stylet (*A.S.* and fig. 64) about three times as long as broad at maximum; with two ventromarginal bristles and a very long apical one. Ventral anal lobe (*V.A.L.* and fig. 62) not markedly

angled; with five short thin dorsomarginal bristles; two very long apical ones; two short stout ones and one thin one near ventral angle and three to five small median or submedian ones. Spermatheca (*SP.* and fig. 63) of *Promyscopsylla* type, thin-walled and with neck gradually merging into head, lacking a distinct demarcation between the two; neck much shorter than the subovate body, upturned.

*Types.* Holotype male *ex* an underground nest, probably of *Mus bactrianus kakhyensis*; North Burma: six miles north of Myitkyina, 27 March 1945, coll. R. Traub for United States of America Typhus Commission. Allotype female *ex* *Mus bactrianus kakhyensis* Anderson, 21 March 1945, otherwise same data. Holotype and allotype deposited in U. S. National Museum. Paratypes (three males and ten females) with above data; deposited in Chicago Natural History Museum, British Museum, Rocky Mountain Laboratory of U. S. Public Health Service, the author's collection and in other institutions.

*Remarks.* The species is named for Captain J. A. V. Girsham of the Kachin Rifles, who after having distinguished himself in combat in North Burma with United States and allied troops, served with the United States of America Typhus Commission as mammalogist, and to whom all members of the Commission are deeply indebted.

#### Family Pulicidae

##### Subfamily Pulicinae

#### 1. *Ctenocephalides felis orientis* (Jordan)

While no effort is made in this paper to list records of cosmopolitan species such as this, it is worthy of note that this species is fairly common on carnivores in North Burma and in Malaya. The author, as well as D. D. Millspaugh, and other members of the United States of America Typhus Commission collected it from a tiger, a leopard, and various civets near Myitkyina, Burma, in 1945. In Malaya I have taken it from civets and from *Felis bengalensis*, near Kuala Lumpur.

#### 2. *Xenopsylla cheopis* (Rothschild)

Despite having examined hundreds of living *Rattus*, representing eight or more species and subspecies, I have not yet collected this flea from hosts trapped in the jungle or on estates near Kuala Lumpur, Malaya. However, it seems to be fairly common on town rats in that vicinity, at least during the drier months, and probably at that time it also occurs in rural areas in limited numbers. In North Burma in 1945 our experience with *X. cheopis* was quite similar. There, however, the species was occasionally collected on field rats (*Rattus rattus sladeni* and *R. flavipectus yunnanensis*) in the dry season.

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**A NEW GENUS OF PHLAETHRIPIDAE FROM MEXICO**

(THYSANOPTERA)

By LEWIS J. STANNARD, JR., *Illinois Natural History Survey, Urbana, Illinois*

Near Mexico City in the neighboring state of Puebla, Mr. Alvarez, in 1945, collected this new genus presumably from ground litter. These specimens, herein described, are not striking in their appearance, nor is it particularly unusual for new genera still to be found in Mexico. The noteworthy feature of this genus is its apparent relationship to two fossil thrips known from Baltic amber.

After comparisons had been made with forms and descriptions available to me, this species was sent to Prof. Dr. Hermann Priesner for his comments. He has written that it resembles *Cephenothrips* and *Necrothrips*, both fossils of his own description, but that it differs in many ways from either one of them.

My sincerest appreciation is accorded Dr. Priesner for his advice and suggestions and to Dr. F. Bonet for giving me the opportunity to study his collection of Thysanoptera from whence this species came.

**Puebllothrips, new genus**

Integument generally smooth, striations of the body except for the meso- and metascutum weak and indistinct; head (fig. 1) slightly broader than long, setae minute; eyes of moderate size, nearly as long as the cheeks (lateral margins of head measured from the base of eyes to base of head), ventral and dorsal aspects similar; ocelli present; mouth cones short and bluntly rounded, extending posteriorly from the head a distance about equal to the cheek length; antennae 8-segmented, areola of segment II located near the apex, segment III normal in size (fig. 3) with three apical sense cones, segment VIII not petiolate although slightly narrowed at base; sclerotized portion of pronotum broader than long and much broader than the head width, mid length about one half as long as head length, only posterior lateral setae developed, dilated at tip, other major